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Specification

Drier for a Web of Material

The present invention relates to a dryer for a web of material in accordance with the preamble of claim 1 or 2.

If such a paper web is processed in a folding apparatus immediately after having been imprinted, without the printing ink having sufficient time for drying, there is the danger that, because of the contact with the rollers of the folding apparatus, ink is smudged or is transferred from one web to another because of the contact between several webs of material being processed simultaneously in the folding apparatus. Modern printing presses attain such high web speeds that the length of time between imprinting a web section and its arrival at the folding apparatus is of a length of only small fractions of a second. Sufficient drying of the ink is not possible during this length of time if it is not speeded up by technical aids.

Drying devices for drying a freshly imprinted web of material are known from DE 41 33 555 A1 or DE 44 29 891 A1, for example.

DE 41 33 555 A1 describes a rotogravure printing press with several printing rollers for multi-color printing wherein, after passing over every individual printing roller, a web of material travels over a transport path whose direction is changed at several rollers, on which drying devices are arranged. Here the course of the transport path has been selected in such a way that the first change of direction rollers over which the web of material runs after having passed through a printing gap touch the non-printed

back of the web. Only after the web has passed through the drying devices and there is no longer the danger of smudging the ink by contact with the change of direction roller, change of direction rollers follow, which also touch the imprinted surface of the web.

In connection with printing presses for imprinting both sides, the construction known from DE 41 33 555 A1 cannot be used, since contact of the freshly imprinted web with a change of direction roller, or any other arbitrary surface, is to be avoided as long as the printing ink has not dried completely.

Therefore DE 44 29 891 A1 uses a longitudinally extending drying oven for drying a web which is imprinted on the front and back, through which the web runs in a straight line. It would actually be desirable to be able to conduct the web vertically upward in the same direction in which it leaves the printing group through the drying oven in order to prevent in this way contact of the not yet completely dried web with a change of direction roller. However, such an arrangement would reach a structural height of several meters. Therefore it would be difficult to install such a machine in a work room. To avoid this, and for being able to install the drying oven horizontally, a change of direction roller between the outlet of the printing group and the inlet of the drying over has to be accepted. Although the arrangement with a horizontally oriented drying oven described in the mentioned publication does not require any external height of the work room for its installation, it requires a considerable base area, since a length of several meters of the drying oven is required for achieving a dwell

time which is sufficient for drying the ink on the imprinted web of material in the drying oven. Although a portion of this area can be used for installing roll changers for the printing group underneath the drying oven, yet for reducing the space requirement of such a printing installation it is necessary to be able to reduce the length of the drying oven. This requirement occurs to a greater extent the higher the web speeds are in the printing installation. For assuring sufficient drying with increasing web speeds it is necessary in connection with the known construction to increase the length of the oven proportionally to the web speed.

DE 298 19 202 U1 discloses a dryer in which a web of material is rerouted via turning stations on which air is blown.

DE 100 44 676 A1 and DE 40 33 642 A1 show devices for rerouting a web of material by means of compressed air.

The object of the invention is based on creating dryers for webs of material.

In accordance with the invention this object is attained by means of the characteristics of claim 1 or 2.

The advantages which can be gained by means of the invention consist in particular in that the dryer can be constructed in a very compact manner and has or requires no change of direction rollers which come into contact with the webs of material before they are completely dried. This is achieved in that instead of change of direction rollers, curved change of direction surfaces, equipped with air outlet openings, are employed in the transit channel of the dryer. By creating air cushions by means of the air exiting between the change of direction surfaces and the web of material

looped around them, an extremely low-friction guidance of the web of material is made possible and contact of the web of material with a surface which could lead to smudging of the ink is prevented. For creating a uniform air cushion between the change of direction surface and the web of material it is desirable that the change of direction surface has a radius of curvature which is minimal at an vertex line of the change of direction surface and increases towards each of the edges of the change of direction surface. In particular, such a change of direction surface can have a hyperbolic cross section (particularly in connection with change of direction angles of 90°) or a semi-elliptical cross section.

Air outlet openings are preferably arranged along the vertex line of the change of direction surface.

By means of a plurality of such change of direction surfaces it is possible to conduct a web of material which is to be dried in a compact volume over a great length, so that long dwell times in the dryer can be achieved, even at high web speeds. For intensifying the drying effect, the dryer preferably has heat sources, for example in the form of heat radiators, arranged in the transit channel.

The drying effect can also be intensified by air movement, for this reason air outlet nozzles directed onto the web of material have therefore been provided in the at least one straight section of the transit channel. A heating device in a supply line of the nozzles for heating the air exiting through them can be advantageously assigned to these air outlet nozzles. In particular, the heating device can be a burner.

In a dryer in whose transit channel a plurality of sections provided with air outlet nozzles has been arranged, a heating device is preferably provided in the supply line of the nozzles of at least one of the sections located upstream in the running direction of the web of material, while such a heating device is lacking in the supply line of the nozzles of at least one section located downstream in the running direction of the web of material. While the web of material is heated in this way if the upstream-located section of the web of material and drying is thus intensified, the downstream-located section makes possible a rapid cooling of the web of material.

A pressure pump can be arranged in a supply line for the nozzles for driving the air flow through the nozzles, however, instead of this or additionally it is also conceivable to provide a suction pump for generating a negative pressure in the transit channel. For one, such negative pressure makes drying easier by lowering the boiling temperature of the ink components which are to evaporate, moreover, it can be used for driving an air flow through the nozzles.

For achieving a large web length, along with a compact construction, the transit channel preferably has at least two sections through which the web of material moves in opposite directions. In this case a first section preferably extends from an inlet of the dryer over a first distance in a first direction, and a section which follows it via a change of direction surface, extends over a larger distance which is greater than the first in the opposite direction. Therefore the dryer extends from the inlet in two opposite directions,

which simplifies the mounting of the dryer on a printing group, even if the dryer extends in the said direction, or opposite direction, beyond the printing group.

Exemplary embodiments of the invention are represented in the drawings and will be explained in greater detail in what follows.

Shown are in:

Figs. 1 and 2, schematic sectional views of a change of direction surface for the contactless change of direction of a web of material,

Fig. 3, a basic diagram of a dryer,

Figs. 4 to 7, embodiments of a dryer in accordance with the invention mounted on a printing group.

A schematic sectional view through a change of direction surface 01, also called an air saddle 01 in what follows, for changing the direction of a material web 07, for example a paper web 07, over an angle of 180° is represented in Fig. 1. The air saddle 01 has a housing 02 in the shape of an ellipse which has been halved along its short diameter, and extends in the transverse direction of the web 07 of material (in the direction perpendicular in relation to the drawing plane). The housing 02 can be made of sheet steel, a rigid plastic plate or the like. The cross section of the housing 02 is symmetrical in relation to a plane A which intersects the housing 02 along a vertex line 03. The housing 02 is provided with a plurality of air outlet openings 04 along the vertex line 03, which communicate with a compressed air duct 06 extending in the interior of the housing 02 in the longitudinal direction of the latter. Compressed air exiting the air outlet openings 04 is

distributed between the housing 02 and a web 07 of material looped around the housing 02 and in this way forms an air cushion which maintains the web 07 of material at a distance from the surface of the housing 02. The excess pressure between the housing 02 and the web 07 of material required for maintaining an air cushion of a thickness of typically 0.3 to 0.5 mm is a function of the tension in the web 07 of material. It is therefore possible to provide pressure sensors on the surface of the housing 02 around which the web 07 of material is looped, or also in the compressed air duct 06, wherein by means of the values measured by them the web tension is controlled and, if necessary, an emergency stop of a press containing the change of direction surface can be initiated if the detected pressure indicates a web tear or other error.

Fig. 2 shows a sectional view analogous to the one in Fig. 1 through an air saddle 01 with a change of direction angle of 90°. The functional principle is the same as with the air saddle 01 in Fig. 1; air, which exits through the compressed air duct 06 and through air outlet openings 04 arranged along a vertex line 03 of the housing 02, is distributed between the surface of the housing 02 and a web 07 of material looped around the latter and in this way creates an air cushion which allows a substantially friction-free conveyance of the web of material 07.

Differing from the exemplary embodiments in Figs. 1 and 2, half an air saddle could also have an asymmetric cross section. In such a case the vertex line 03 of the housing 02 is defined as that line on the surface of the housing 02 which contacts an imaginary plane which extends

perpendicularly in relation to a sum F_{Σ} of the tensile force vectors F_V, F_R acting on the web 07 of material upstream and downstream of the change of direction surface 01. The amount of air put through the change of direction surface required for building up an air cushion is reduced.

Fig. 3 shows a basic diagram of a dryer equipped with air saddles 11, 12, 13 in accordance with Fig. 1 or 2. The direction of a web 07 of material to be dried is changed by 90° at a circumferential face 11, for example an air saddle 11, for example an inlet air saddle 11, extends straight through a transit channel 08, for example a gap 08 between two plates 14 provided with air outlet nozzles, loops around a circumferential face 12, for example an air saddle 12, for example a 180° air saddle 12, passes through a second gap 08 to a circumferential face 13, for example an air saddle 13, for example an outlet air saddle 13, and leaves the dryer from there in a horizontal direction. Each of the plates 14 provided with air outlet openings delimits chambers 16 which, like the compressed air ducts 08 of the air saddles 11, 12, 13, are connected with a pressure pump. Two pressure pumps 17, 18 are represented in Fig. 3, one of which supplies the air saddles 11, 12, 13, and the other the chambers 16. It is necessary to supply the air saddles 11, 12, 13 with a higher pressure than the chamber 16. It would of course also be possible in principle to supply the air saddles 11, 12, 13 and the chambers 16 by means of a common pressure pump and in the course of this to make use of flow resistance in the supply lines leading from the pressure pump to the air saddles 11, 12, 13, or the chambers 16 in order to provide the former with a higher excess pressure than the latter.

Fig. 4 shows a first exemplary embodiment of a dryer 22 mounted on a printing group 21. A transit channel of an imprinted web 07 of material coming vertically from below out of the printing group 21 is comprised of an air saddle 11, for example a 90° air saddle 11 and a horizontally oriented gap 08 between plates 14, which are provided with air outlet nozzles. Except for the nozzles and an inlet and outlet slit for the web 07 of material, the plates 14 constitute a substantially sealed housing, with which a suction pump 26 is connected for generating a negative pressure in the gap 08. The negative pressure causes the inflow of fresh air into the gap 08 via supply lines 27, which are here constituted by spaces between the plates 14 and an outer housing 28 of the dryer 22. In the embodiment considered here, fresh air flows substantially over an outlet 24 of the dryer 22, out of which the web 07 of material is conducted. The fresh air can be pre-heated by a heating device (not represented in Fig. 4). The web 07 of material exiting the outlet 24 loops around a cooling roller 29 and finally reaches the folding apparatus 31.

A further developed embodiment is represented in Fig. 5. The printing group 21 is the same as in the embodiment in Fig. 4. It comprises two component groups 32, 33 containing plate cylinders, each of which imprints the same side of the web 07 of material and which can be moved apart in a frame 34 for allowing access to the plate cylinders.

The housing 28 of the dryer 22 extends over the entire width of the frame 34. The inlet 23 for the web 07 of material lies approximately in the center of the underside of the housing 28. A 90° air saddle 11 arranged on it guides

the web 07 of material coming from the printing group 21 into a first horizontal straight section 36 of the transit channel of the dryer 22 which extends, starting at the inlet 23, in a direction leading away from the folding apparatus 31. At an 180° air saddle 12 the section 36 makes a transition into a second horizontal straight section 37, which guides the web 07 of material in the opposite direction to an outlet 24 adjoining the folding apparatus 31. From there the web 07 of material runs over a cooling roller 29 to the folding apparatus 31.

In relation to a plane 43 determined by the vertically extending web 07 of material, the first section 36 is arranged on only one side of the plane 43, wherein the second section 37 is arranged on both sides of the plane 43. The second section 37 is at least twice as long as the first section 36.

Here, the sections 36, 37 of the transit channel are each bordered by guide plates 38, which conduct a fresh air flow, which enters the housing 28 of the dryer 22 at an outlet 24 and is driven by a pump, not represented, closely adjacent to the web 07 of material. The fresh air flow, which can also be pre-heated, moves at high speed along the web 07 of material and in this way provides effective drying. In the embodiment represented here, an air outlet 42 is located on the front of the housing 28 opposite the outlet 24, and the lower one of the two guides plates 38 bordering the section 37 is interrupted at the level of the inlet 23, so that the air flow can be split and a part of it can reach the air outlet 42 along the first section 36. It would of course also be possible to provide the air outlet 42 at the

inlet 23 for the web 07 of material in order to force the air flow in this way to flow through the transit channel 08 along its entire length.

In a variation of this embodiment, the air supply to the straight sections 36, 37 is provided as in the embodiment in accordance with Fig. 4 via chambers 39 separated from the transit channel by means of the guide plates 38 and by nozzles formed in the guide plates 38.

The embodiment of Fig. 6 differs from the one in Fig. 5 in that the guide plates 38 in the first section 36 of the transit channel 08 and in the half of the second section 37 remote from the folding apparatus 31 have been replaced by heat radiators 41, for example electrically operated heating rods. A pump (not represented) drives a fresh air flow, which flows through the housing 28 of the dryer 22 from the outlet 24 to an air outlet 42 formed on the oppositely located front face of the housing 28. With this embodiment the inflowing fresh air need not be pre-heated, to the contrary it is used for cooling the web 07 of material in the right half of the section 37 in a counter-flow, so that a cooling roller 29 between the dryer 22 and the folding apparatus 31 can be omitted.

An embodiment for a high drying output is represented in Fig. 7. As already shown in Fig. 3, with this embodiment the sections of the transit channel 08, here identified by 36.1 to 36.5, are surrounded by chambers 16.1 to 16.5, whose wall plates facing the transit channel 08 are supplied with air outlet nozzles. A total of five sections has been provided, wherein the chambers 16.1, 16.2, 16.3 of the three sections 36.1, 36.2, 36.3 which, in respect to the transport

direction of the web 07 of material, are located upstream in the dryer 22 are provided with heated gases from a burner, and the chambers 16.4, 16.5 of the downstream located sections 36.4, 36.5 are provided with unheated fresh air in order to pre-cool the web 07 of material already prior to its reaching a group of cooling rollers 29. The output of such a dryer 22 is sufficient for heatset drying.

The fact that the dryer 22 can be mounted on a printing group 21 without increasing the space requirements or the required distance from other presses of the latter, predestines the dryer 22 particularly for retrofitting on already installed printing presses. In this way the possibility is created to also imprint higher quality paper with reduced absorption ability than customary newsprint, in particular paper with a coated surface, on such presses. The field of application of such printing presses is thus increased, so that they can also be used during the day, during which no newspaper are to be printed. By means of this the efficiency of such a printing press can be considerably increased.

List of Reference Symbol

01	Change of direction surface, air saddle
02	Housing
03	Vertex line
04	Air outlet opening
05	-
06	Compressed air duct
07	Web of material, paper web
08	Transit channel, gap
09	-
10	-
11	Change of direction surface, air saddle, inlet air saddle, 90° air saddle
12	Change of direction surface, air saddle, 180° air saddle
13	Change of direction surface, air saddle, outlet air saddle
14	Plates
15	-
16	Chamber
17	Pressure pump
18	Pressure pump
19	-
20	-
21	Printing group
22	Dryer
23	Inlet
24	Outlet

25	-
26	Suction pump
27	Supply line
28	Housing, outer
29	Cooling roller
30	-
31	Folding apparatus
32	Component group
33	Component group
34	Frame
35	-
36	Section, straight line, first
37	Section, straight line, second
38	Guide plate
39	Chamber
40	-
41	Heat radiator
42	Air outlet
43	Plane
A	Plane
F_{Σ}	Sum
F_V	Tensile force vector
F_R	Tensile force vector
36.1	Section
36.2	Section
36.3	Section
36.4	Section

36.5	Section
36.6	Section
16.1	Chamber
16.2	Chamber
16.3	Chamber
16.4	Chamber
16.5	Chamber